NATIONAL ACADEMY SCIENCE LETTERS

Volume 5 January 1982 Number 1

NATIONAL ACADEMY OF SCIENCES
INDIA

National Academy

SCIENCE LETTERS

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Publisher :

Prof. H. C. Khare
Hony. General Secretary
National Academy of Sciences, India
5, Lajpat Rai Road, Allahabad—211002. U.P., India

National Academy
SCIENCE LETTERS

January 1982

Volume 5 *No.* 1

ADDITIONS TO THE GRAMINEAE OF RAJASTHAN

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Received, Sept. 18, 1981

During a geobotanical survey of the vegetation of the district of Udaipur over the last five years, the authors collected a total of 136 species of grasses. Out of these species 13 are new records for the state of Rajasthan.

The flora of the different parts of the state of Rajasthan has been studied by a number of workers like King (1879), Macadam (1890), Blatter and Hallberg (1918-1921), Sutaria (1941), Sankhala (1951), Raizada (1954), Sarup (1954, 1957, (1958), Nair (1961), Nair and Nathawat (1956), Joshi (1956, 1957), Raizada *et al* (1957), Sharma (1958), Jain (1960, 1962, 1972), Puri *et al* (1964), Vyas and Ramdeo (1964), Verma *et al* (1965), Vyas (1965) and Ramdeo (1969). A perusal of this literature reveals that the work on the systematics of grasses is meagre and sketchy. Only Ramchandran (1950), Gandhi *et al* (1961), Prakash and Nanda (1961) and Kanodia and Rao (1965, 1966), have dealt exclusively with the grasses. Recently, Bhandari (1978) described 90 species of grasses under 52 genera from the Thar desert. Sharma and Tiagi (1979) described 91 species under 53 genera in their flora of North-East Rajasthan.

A critical study of the available literature reveals that though the South-Eastern parts of Rajasthan support a relatively luxuriant vegetation, yet it remains mostly unexplored.

The area of the present investigation comprises the district of Udaipur having an area of about 17,267 Sq Km, situated between the parallels 23°49′ – 25°28′ North latitudes and 73°01′ 75°49′ East longitudes. During a geobotanical survey of the vegetation of the district of Udaipur, the authors collected 136 species of grasses. A study of the earlier literature on the subject shows that the following species had not yet been recorded to occur in Rajasthan. The list is arranged according to Bor (1960). Nomenclatural changes proposed by Jain and Deshpande (1978) and Shukla and Jain (1978) have also been incorporated in the present work. A set of these specimens have been deposited in the herbarium of Forest Research Institute, Dehradun and another in the Geobotany herbarium of Department of Botany, School of Basic Sciences and Humanities, University of Udaipur, Udaipur. Sheet numbers of the species deposited in the Geobotanical herbarium of this department are given in parenthesis.

Group : PANICOIDEAE

Tribe : ANDROPOGONEAE

Dichanthium filiculme (Hook. f.) Jain *et* Deshpande (942)

Dichanthium glabrum (Roxb.) Jain *et* Deshpande (634)

Hemarthria altissima (Poir.) Stapf *et* C. E. Hubb. (776)

Sorghum deccanense Stapf (710)

Tribe : PANICEAE

Digitaria bicornis (Lamk.) Roem. (772)

Digitaria setigera Roth (246)

Panicum cambogiense Balansa (854)

Pennisetum orientale L. C. Rich. (590)

Group : POOIDEAE

Tribe : CHLORIDEAE

Cynodon barberi Rang. *et* Tad. (812)

Melanocenchris monoica (Rottl.) C. E. C. Fisch. (838)

Tribe : ERAGROSTIDEAE

Leptochloa chinensis (Linn.) Nees (348)

Leptochloa panicea (Retz.) Ohwi (516)

Tripogon hookerianus Bor (564)

We are grateful to the U. G. C. for massive financial support for a major research project under which this work was carried out.

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Nat. Acad. Sci. Letters, Vol. 5, *No.* 1, 1982

EFFICACY OF DIFFERENT FUNGICIDES AGAINST COMMON DISEASES OF *AGARICUS BISPORUS* UNDER THE ECOLOGICAL CONDITIONS OF KASHMIR

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Received, March 28, 1981.

The present study communicates the results of the relative efficiency of fungicides like Delan, Saprol and Dithane M/45 against common diseases of *Agaricus bisporus* under ecological conditions of Jammu and Kashmir State. The results obtained indicate that disease attack results in decreased yield. Use of suitable and effective fungicides not only minimises the chances of disease attack as in case of Dithane M-45 but also can check up to a greater extent the attack of diseases as in case of Delan and Saprol and give increased production.

The commercial cultivation of European mushroom, *Agaricus bisporus* under controlled conditions was introduced in the temperate regions of Jammu and Kashmir State during 1964-65 on experimental basis by the Department of Agriculture, Jammu and Kashmir State and at present there are more than 1000 trained private growers in the State.

The State is inhabited mostly by poor farmers and about 75% of the mushroom growers are from this stratum. These farmers being economically backward have adopted mushroom cultivation as a cottage industry to supplement their income. The growers of the State can not afford pasteurization of compost due to lack of boiler facilities and hence have adopted long composting method for making compost thereby providing maximum chances of contamination by pathogens. Besides, the mushroom cultivation by growers of the State is carried out almost under natural conditions without much variation in the prevailing room temperature and humidity at the mushroom farms thereby intensifying the disease attack. The yield of mushrooms is considerably reduced as a result of it.

The mushrooms in general are attacked by numerous major as well as minor diseases depending upon ecological conditions and location of the mushroom farm.

In Jammu and Kashmir State, the diseases which commonly attack *Agaricus bisporus* are given below:-

1. *Diehliomyces* sp. (Truffle disease)
2. *Chaetomium globosum* (Green mould)
3. *Dactylium* sp. (Mildew)
4. *Fusarium* sp. (Damping off wilt)
5. *Mycelioptlora* (Yellow mould)
6. *Papulaspora* sp. (White plaster mould)
7. *Scopulariopsis* sp. (White plaster mould)
8. *Verticillium* sp.
9. *Bacterial* spot (Bacterial blotch)

A good deal of work has already been done by the Mushroom Research and Development Scheme of

the Department of Agriculture to minimise the attack of various diseases in order to improve productivity. In this respect fungicides like Benlate, Bavistin and Dithane M-45 have already been tried for control of various diseases and have given encouraging results. But Benlate and Bavistin being systemic fungicides could not be used during mushroom flushes mostly because of their residual effect which lasts for many days. Thus the need to use safer fungicides emerged. The present study is a step towards that direction for achieving higher production with consideration of cost-benefit ratio. The objective of the trial was to study the relative efficiency of fungicides like Delan, Saprol and Dithane M-45 against some common diseases of *Agaricus bisporus*. The trials were conducted at the Mushroom Research Laboratory of Agriculture complex, Lalmandi, Srinagar and also at the grower's farm.

The substrate taken for mushroom growing was paddy straw compost. The ingredients used for its preparation were as follows :—

1.	Paddy straw	500 kg
2.	Mollases	20 kg
3.	Oil cakes	60 kg
4.	Rice bran	30 kg
5.	Urea	5 kg
6.	Gypsum	30 kg
7.	Chicken manure	50 kg

The synthetic compost prepared by long composting method was given 6-turnings. Each turning was given at an interval of four days.

The compost was ready for use after 25 days and the finished compost has these characteristics :—

1. *Colour* : Slightly brown
2. *Compactness* : Slightly compact
3. pH *value* : 7.5
4. Total Nitrogen supplied through oil cakes, rice bran, urea and straw 1.5%
5. Total Nitrogen available at the time of filling of compost in the trays 2.2%
6. *Moisture content* : 60%
7. *Temperature* : 30°C
8. *Smell* : Plesaant, free from Ammonia

The compost was filled in the trays covering a total bed area of 192 square feet. Out of this 144 square feet bed area was taken for various fungicidal treatments and 48 square feet bed area was taken as untreated control. The trays were spawned with *Agaricus bisporus* LS-11 strain using about 100 gm spawn per 6 feet bed area. The temperature and humidity during the spawn run were maintained at 20-25°C and 80-90% respectively. The trays were cased exactly 15 days after spawning using peat and sterilized soil (2 : 1) as a casing material of pH 7.5. The pin heads emerged after 16 days of casing and crop was over in 40 days after emergence of pin heads in 4 flushes. The fungicides tried included Delan (@ 1 gm. in 5 litre of water Saprol (Funginex Triforine 20), 1 ml in 5 litre of water and Dithane M-45, 1 gm. in 2 litre of water.

Each fungicide was sprayed over a total area of 48 square feet bed area in different replications. The schedule of spraying was :

Ist Spray :

At the time of filling of compost in the trays, 100 ml of each fungicidal solution was sprayed per square feet bed area and the compost was mixed thoroughly before filling.

IInd Spray :

At spawn run stage i. e. after spawning, 50 ml of fungicidal solution was sprayed per square foot bed area.

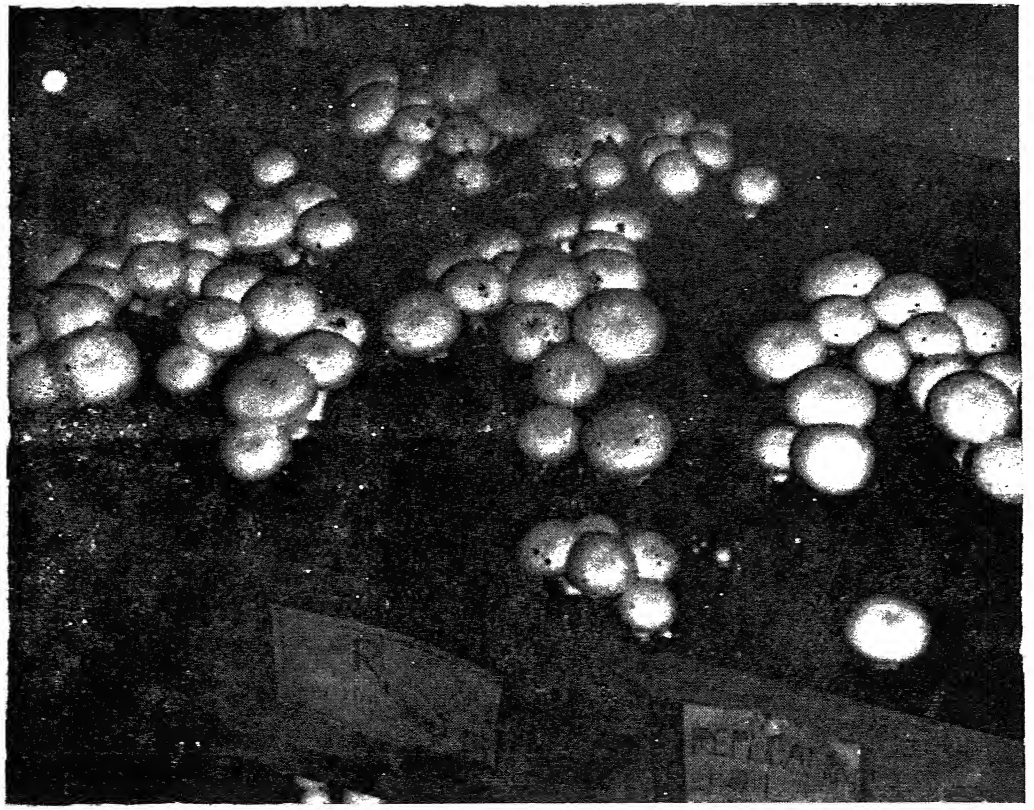
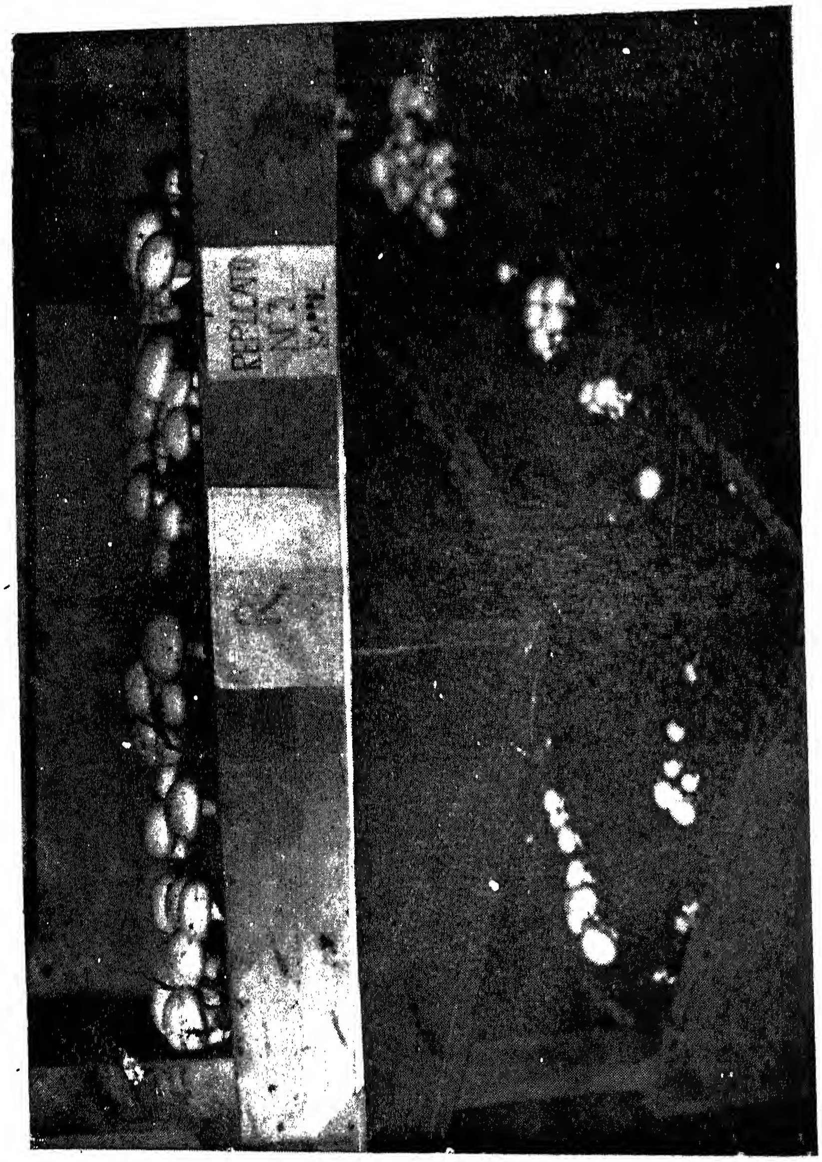


Fig. 1 *Agaricus bisporus* Treated with Delan



IIIrd Spray :

After casing, 75ml of fungicidal solution was used per square ft. bed area.

IV th Spray :

At pin head stage, 50 ml of fungicidal solution was used.

Vth Spray :

It was given during mushroom flushes, 50 ml of fungicidal solution was used.

The yield was recorded in different treatments, which varied considerably. Data are given in the following table :

Table showing the yield of mushrooms in different treatments

Treatment	Yield of mushrooms per sq. ft bed area (kg)*
Delan	0.5114
Saprol	0.4735
Dithane M-45	0.4556
Control	0.2687

*Depth of compost -6 inches

Temperature during cropping 14 - 18°C

Relative humidity 70 - 80%

Spawn run was uniform in all the cases after Ist spray which was done at filling stage. Slight attack of *Papulospora* sp. (Brown plaster mould) was observed in untreated trays after 2nd spray. The trays sprayed with Delan and Saprol were found free from any disease attack with healthy spawn run after 3rd spray, but the attack of *Papulaspora* sp. was clear in untreated trays accompanied with white plaster mould (*Scopulariopsis* sp). The trays sprayed with Dithane M-45 showed mild attack of *Dactylium* sp. (Mildew) at some spot. After 4th and 5th spray, the intensity of disease attack increased over the entire compost in control thereby adversely affecting the yield. However, the trays sprayed with Delan and Saprol remained free from disease attack throughout resulting in higher yield. Slight attack of *Dactylium* sp. was noticed in Dithane treatment.

Maximum yield was obtained in Delan treatment (Fig. 1) followed by saprol (Fig. 2) and Dithane M-45. Minimum yield was obtained in control (Fig. 3). Similar trials at the grower's farms were also undertaken and the results obtained were similar.

We are thankful to E. Merck (India) Pvt. Ltd. Bombay for sparing samples of fungicides to us., to Dr. S. P. Ray Choudhury, who visited our research centre and the field and gave valuable suggestions from time to time and also to Shri H.U. Khan, Director of Agriculture, Jammu and Kashmir State for his kind encouragement and for providing every facility.

We are also thankful to Spawn Production unit, Srinagar and Mushroom Development Officer, Srinagar for their co-operation.

Nat. Acad. Sci. Letters, Vol. 5, No. 1, 1982

FUNGITOXIC ACTIVITY OF LEAVES OF SOME HIGHER PLANTS

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Received, Aug. 1981; *revised, Dec.* 17, 1981

Thirty one plant species were screened for their fungitoxicity against *Colletotrichum falcatum* and *Rhizoctonia solani*. The leaves of *Allamanda cathartica* and *Artabotrys hexapetalus* showed absolute toxicity against both the fungi while the leaves of *Polyalthia longifolia* were toxic only against *C. falcatum*.

Leaf extracts of some higher plants were screened against *Colletotrichum falcatum* and *Rhizoctonia solani* causing severe diseases to sugarcane and pulses respectively.

Ethanolic extracts of leaves of various plants of the area were subjected to antifungal testing against the test fungi by the modified paper disc technique of Sharville and Pelletier (1956)[1]. The fungitoxicity of the leaf extracts was recorded in terms of percent mycelial inhibition by the formula:

$$\% \text{ mycelial inhibition} = \frac{d_c - d_t}{d_c} \times 100$$

where d_c = average colony diameter in control, and,

d_t = average colony diameter in treatment.

Out of thirty one plant species screened, the leaf extracts of *Allamanda cathartica* and *Artabotrys hexapetalus* showed absolute toxicity against both the test fungi (Table-1). The leaf extract of *Polyalthia longifolia* was toxic only against *C. falcatum*. Leaf extracts of *Ageratum conyzoides*, *Aegle marmelos*, *Acalypha indica*, *Euphorbia geniculata*, *Kerganelia reticulata*, *Mirabilis jalapa* showed moderate toxicity against both the test fungi but *Clerodendrum splendens*, *C. viscosum*, *Cinnamomum temala*, *Mentha sylvestris*, *Melia azadirachta* and *Spathodea campanulata* showed moderate activity against *C. falcatum* only.

Sincere thanks are due to Prof. S. N. Dixit for guidance, to the Head, Department of Botany for facilities and to C. S. I. R. New Delhi for financial help.

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TABLE 1

Screening of plants for their fungitoxicity against *C. falcatum* and *R. solani*

Plants	Percent mycelial inhibition	
	C. falcatum	*R. solani*
Acalypha indica	68.9	92.4
Aegle marmelos	73.4	64.6
Ageratum conyzoides	55.5	86.4
Allamanda cathartica	100	100
Annona squamosa	42.9	66.6
Antigonon leptopus	56.6	94.4
Artabotrys hexapetalus	100	100
Blumea membranosa	57.8	20.0
Clerodendrum inerme	38.4	51.4
C. splendens	66.6	47.3
C. viscosum	76.0	21.7
Cinnamomum tamala	41.9	15.7
Cosmos sp.	94.3	23.6
Datura alba	47.6	31.0
Encalyptus sp.	42.3	52.5
Euphorbia geniculata	50.0	72.0
Filicum desipiens	58.9	50.0
Heliotropium indicum	46.5	50.3
Hyptis suaveolens	3.8	56.4
Kerganelia reticulata	78.2	90.0
Lantana indica	48.2	33.3
Melia azadirachta	60.5	36.5
Mentha sylvestris	59.5	25.5
Mirabilis jalapa	56.8	90.0
Murraya koenighii	61.3	66.6
Ocimum sanctum	10.0	33.3
Polyalthia longifolia	100	25.5
Sapindus emarginatus	73.5	25.5
Spathodea campanulata	55.8	22.1
Tagetes erecta	45.0	36.0
Vitex negundo	58.6	32.2

– indicate accelaration in growth.

Nat. Acad. Sci. Letters, Vol. 5, No. 1, 1982

TECOMA STANS-A NEW HOST FOR *COLLETOTRICHUM GLOEOSPORIOIDES*

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Colletotrichum gloeosporioides Penz. has been observed to cause leaf spot disease of *Tecoma stans* (L.) H.B. and K. The Morphology, cultural characters and pathogenicity of the causal organism have been described. The host is new to this pathogen.

A serious leaf spot disease on *Tecoma stans* (L.) H.B. and K. has been observed during the rainy seasons, for the last few years in the Punjab University Campus, Chandigarh. The symptoms are as follows: Leaf spots circular, up to 8mm in diameter, irregularly circular or elongated, light greyish to dark brown, with small dot like inconspicuous scattered acervuli (on upper side of the leaves) and with light brown margin.

Morphological studies of the pathogen have revealed the acervuli as light to dark brown, mostly circular, innatoerumpent, up to 160 μm in diameter. Setae dark brown, thick walled, smooth, 1-3 (4)septate with basal cell swollen, 2-25 per acervulus, mostly marginal, apex obtuse, 28-65 × 3.5-4.5 μm. Conidiophores hyaline, simple, continuous, cylindric, each bearing a single apical conidium, 8 - 15 × 3 - 4.5 μm. Conidia hyaline, oblong to ovato-oblong, smooth, cylindric, mostly straight, 1-celled, biguttulate, 11—15 × 3.5 – 5.8 μm.

In a moist chamber, conidia germinate in a drop of water at 28°C after 3 hrs. Growth of the colony (obtained from a monosporic isolate) after 8 days at 28°C on potato-dextrose-agar had an average diameter of 7 cms. The colony was circular with entire margin, slightly fluffy, dull white to light grey and reverse translucent.

The inoculations with conidial suspension on the young leaves produced typical symptoms within twelve days after inoculations at 30°C (±1) in saturated atmosphere.

The above morphological description of the causal fungus resembles the description of *Colletotrichum gloeosporioides* Penz[1]. The fungus does not seem to have been recorded on this host before. The

material as well as culture have been deposited the Herbarium, Botany Department, Punjab in University, Chandigarh (PUH 90005).

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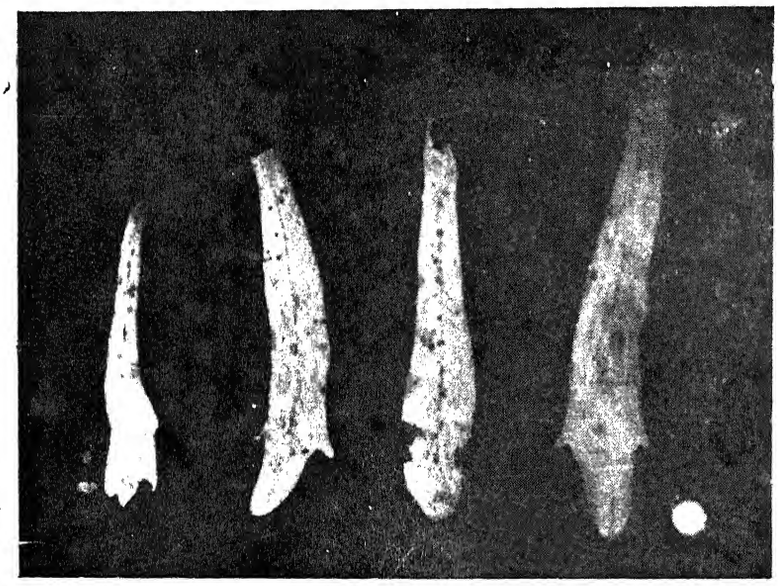

Fig. 1. Symptoms on candytuft leaf.

Nat. Acad. Sci. Letters, Vol. 5, *No.* 1, 1982

LEAF SPOT OF CANDYTUFT CAUSED BY *ALTERNARIA RAPHANI*

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Received, June 9, 1981; *revised, Sept.* 14, 1981

Leaf spot disease of candytuft (*Iberis amara* L.) caused by *Alternaria raphani* Groves and Skolko is being reported for the first time from India. The pathogen was also able to infect other members of Cruciferae like turnip, radish, cabbage and cauliflower.

A leaf spot disease of candytuft (*Iberis amara L.*) was found prevalent in the month of January, 1981 in the Horticultural Gardens of the University. Microscopic examination of affected leaves and isolations made from them yielded *Alternaria raphani.*

The disease initially appears as small, scattered, grey spots on leaf lamina. Later, these spread rapidly to form almost circular spots, 3-8 mm in diameter, brown to dark brown with raised yellow margins and distinct zonations. The centre of spots dries and may drop-out.

The fungus was readily isolated on PDA by usual method and pathogenicity established on healthy leaves of candytuft. The pathogen was also able to infect turnip, radish, cabbage and cauliflower in artificial inoculations.

The morphological observations of the fungus were made in nature (host) and on artificial culture medium (PDA).

On the basis of the morphological characters, pathogenicity and host-range, the fungus is identified as *Alternaria raphani* Groves Skolko[2].

A. raphani has earlier been reported from different parts of the world on several Cruciferous plants including candytuft, like cabbage, cauliflower, radish, rape, turnip, *Matthiola* and *Brassica* spp. (Wiltshire[4], Changsri and Weber[1] and Narain and Saksena[3]). But from India this appears to be a new report on candytuft showing severe leaf spotting.

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Nat. Acad. Sci. Letters, Vol. 5, *No.* 1, 1982

SIMPLE PHOTOMETRIC ESTIMATIONS OF HYDROGEN PEROXIDE

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Received Nov. 13, 1981 *revised Feb.* 3, 1982

Two new reagents (Orthoamino phenol-ferrous sulphate and N,N dimethyl aniline-copper acetate) have been used in the photometric determinations of hydrogen peroxide.

Hydrogen peroxide is a widely sited antiseptic. The typical reported methods for the micro estimation of hydrogen peroxide include either colour formation with reagent[1-7] or decrease in the intensity of the coloured reagent.[8-12] The present photometric methods are based on the formation of coloured species when hydrogen peroxide is added to either orthoamino phenol-ferrous sulphate or N, N-dimethyl aniline-copper acetate under proposed experimental conditions and the concentration of coloured species in each case is directly proportional to the concentration of the hydrogen peroxide initially taken.

Spectral and absorbance measurements were made with Bauch and Lomb Spectronic-20 spectrophotometer with 1 cm glass cells. The pH of the solution was adjusted to the desired value using an Elico model LI-120 digital pH meter. Freshly prepared solutions of N,N-dimethyl aniline, O-amino phenol, copper acetate and ferrous sulphate (pure samples) in pH 1.4 buffer were always used. Glycine-HCl (pH 1.0-2.1) and potassium acid phthalate-HCl (pH 2.2-3.7) buffer solutions were prepared according to the procedure given by Lurie[13]. Hydrogen peroxide solution (30%) was suitably diluted with water and standardised iodometrically (600 μg/ml) for calibration purposes, this solution was further diluted volumetrically 1 to 20 and 1 to 100. The concentrations of hydrogen peroxide in these latter solutions were determined periodically by employing the well known colorimetric potassium iodide reagent[1].

Method A: O-amino phenol-Ferrous sulphate reagent

15ml of 1.4 pH buffer solution, 1 ml of 0.3% O-amino phenol solution, 1 ml of 1% ferrous sulphate solution and 0.5 to 5ml aliquot of the sample solution containing 3 to 20 μg of hydrogen peroxide were taken in a 25ml volumetric flask and latter diluted to the mark. The absorbances of all the solutions were measured against their reagent blank at 410nm after 20 min. The colour is stable for more than 3 hr.

Method B: N, N - dimethylaniline—copper acetate reagent :

To a 25ml volumetric flask, these solutions were added in the following order. 15ml of buffer (pH. 1.4) N,N-dimethyl aniline (1.0 ml, 2.4%), cop-

per acetate (1.5 ml, 10 %) and 0.5-4ml of hydrogen peroxide containing 15 μg- 120 μg. The solution was then diluted to the mark. The absorbance was measured at 470 nm between 5min.- 15min. against the reagent blank prepared under similar conditions. The hydrogen peroxide concentration of the sample solution was deduced from the standard calibration graph.

The absorbance curves of hydrogen peroxide with the reagents, Orthoamino phenol-ferrous sulphate (λ max. 400-410 nm), and N,N- dimethylaniline-copper acetate (λ max 470 nm), show characteristic absorption maxima whereas hydrogen peroxide with orthoamino phenol, N,N-dimethyl aniline, copper acetate or ferrous sulphate have practically no or low absorption in this region.

The optimum conditions were established basing on the development of maximum colour and its stability through variation of parameters such as pH, reagent concentration and the results are presented in the procedures.

Beer's law limits, molar absorptivity, Sandell's sensitivity, of methods A and B are given in Table 1.

TABLE 1

Optical Characteristics

Method	Beer's law limits μg/25 ml	Molar absorptivity at absorbance maxima 1 mole^{-1} cm^{-1}	Sandell's sensitivity μg/cm^2/0.005 absorbance unit
A	3.0–20.0	1.42×10^4	0.012
B	15.0–120	3.7×10^3	0.046

The precision of the methods A and B were tested by measuring absorbances of 8 samples, each containing a final concentration of 12 μg in method A and 70 μg in method B, values approximating in the middle of the optimum ranges. The % relative standard deviations in methods A and B are respectively 0.8 and 0.6. The amounts of hydrogen peroxide (Beer's law limits) obtained in methods A and B were found to agree within $\pm$ 0.7% and $\pm$ 0.9% error respectively with the standard method.[4] Effect of diverse ions was studied by preparing synthetic solutions containing known amount of hydrogen peroxide (13.5 μg in method A and 80 μg in method B) and varying amounts of diverse ions and the amount of hydrogen peroxide was determined in their presence. It was found that the following ions present in mg shown in parentheses, (Method A ; Method B) did not cause deviation of more than $\pm$ 2% in absorbance: Cl^- (6;2.3), Br^- (1.3;1.3), I^- (0.4;0.3), NO_3^- (7.5;3.0), NO_2^- (0.02;0.07), CO_3^{2-} (0.9;0.45), SO_4^{2-} (5;1.25), SO_3^{2-} (2.0;1.3), PO_4^{3-} (5.6;0.7), borate (0.5;0.6), acetate (6.0;2.5), citrate (0.6;0.13), tartrate 0.7;0.14), Oxalate (0.01; 0.5), NH_4^+ (3.5;1.5), Na^+ (4.0;1.6), K^+ (3.0;1.2), Ni^{2+} (3.0;0.5), Hg^{2+} (1.5;0.7), Cu^{2+} (2.0;1.0), Pb^{2+} (1.9;1.3), Cd^{2+} (5.4;2.2), Zn^{2+} (2.3;0.9), Mn^{2+} (0.65;0.65), Fe^{3+} (0.018;0.003), Co^{2+} (2.5;1.0) and Al^{3+} (0.9,0.6).

Many of the diverse ions do not interfere in methods A and B even when they are present in large excess. However presence of either oxidising agents or variation in pH leads to abnormal results. Both methods are simple, sensitive, specific and accurate. The sensitivity of the method A appears to be better when compared to most of the methods so far reported for the determination of hydrogen peroxide.

The coloured species formed with 0-ammophenol-ferrous sulphate and N, N-dimethylaniline-copper sulphate appear to be 2 amino phenoxazin-3one[14] and oxidation product of N, N-dimethylaniline respectively through comparison of their spectral data with those of the previously reported ones.

We are grateful to the authorities of Andhra Universlty, Waltair and U.G.C. New Delhi, for the award of teacher research fellowship under FIP ot K.V.S.S.M.

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Nat Acad. Sci. Letters, Vol. 5, *No.* 1, 1982

ON THE OCCURRENCE OF GRAYWACKE IN THE ARAVALLI FORMATION JHAMAR-KOTRA AREA, DISTRICT UDAIPUR, RAJASTHAN

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Received, Dec. 19, 1981 *Revised March* 3, 1982

The present occurrence of graywacke differs from those reported from the Aravallis of other parts of Rajasthan. The lithological sequence does not indicate flyesch facies.

On the basis of structural, textural, and mineralogical features it is suggested that these felspathic graywacke indicate below wave base deposition in a stable basin and probably in a source region free from volcanic activities.

In recent past graywacke has been reported in the Aravallis from various parts of Rajasthan (Poddar and Mathur 1965, Mukherjee and Kapoor 1970). Poddar and Mathur (1965) described the sequence of graywacke and slate-phyllite occurring in a broad belt near Udaipur. Recent discoveries of phosphorite deposits from the twin villages of Jhamar-Kotra (24° 27′-73°40′ and 24° 29′—73°52′) near the above belt generated further interest. An account of graywacke studied from the area forms the subject matter of the present study.

The area is a part of N.W.-S.E. tracing asymmetrical synclinorium. A fault has affected its eastern and southern limb brings Delhi quartzites in juxtaposition to the Aravalli formations. Metamorphic structures such as fracture and slaty cleavages and several sets of vertical and inclined joints mostly affecting the dolomitic limestone, ferruginous silicified limestone and phyllites are recorded. Sedimentary structures like cross bedding or ripple marks are absent in general. The graywacke shows a gradual variation from coarse to fine at places.

The geological succession of the area includes the following (I) Pre-Aravalli banded gneissic complex, (ii) Aravallis consisting of quartzite, dolomitic ferruginous limestone, phosphorite, dolomitic limestone, phyllite, schist and graywacke, (iii) Delhi quartzite followed by phyllite and schist.

The graywacke, in hand specimen is hard and dark coloured, varying from dark grey to bluish grey and at places due to the sub-parallel arrangements of biotite flakes the rock assumes a gneissci appearance. Besides flakes of biotite, a few grains of muscovite and some carbonate material are also

observed. These rocks comprising angular to sub-angular grains of quartz and sub-ordinate plagioclase are poorly sorted and variation in grain size from coarse to medium to fine is observable even megascopically. Their thickness is insignificant in comparison to limestone and phyllite.

Based on modal analysis the mineralogical composition is as follows :

Sp. No.	*Quartz*	*Feldspar*	*Mica and chlorite*	*Rock fragments* and *Matrix*	*carbonate*
J_1	62	21	8	9	tr
J_2	58	18	10	10	4

Quartz grains are on the whole angular to sub-angular. Normally they are free of inclusions. There is no stain effect or gas inclusions and frost action. Composite grains made up of a mosaic of equidimensional grains and doubtful overgrowth of silica matter are located occasionally. Both twinned polysynthetic and untwinned varieties of plagioclase (oligoclase $\times$ O10=0° to 7°) frequently show clouding. The untwinned grains are distinguished from quartz due to their distinct cleavages, alterations and biaxial nature. The dominance of biotite flakes frequently altered to chlorite with greenish colour showing isotropism often impart dark colour to the rock. When fresh they show distinct pleochroism from dark brown to yellow. Presence of pleo chroic haloeis a noteworthy feature. Muscovite is subordinate and colourless. The carbonate is present only in traces. When slightly higher (4 per cent) it is characterized by twinkling and high birefringence. The matrix consists of mica, chloritic material and rock chips including recrystallized quartz etc. Calcareous materials also occur in the matrix and cement.

On comparison with other reported occurrences from the vicinity of Udaipur and southern Banswara the following distinctive noteworthy features are observed in the area : absence of (i) repetitious sequence of graywacke with slate phyllite, (ii) pebble conglomerate, (iii) any volcanic rock in the vicinity, (iv) cross bedding in the basal quartzite.

Absence of rhythmic interbedding may be due to sedimentation locale. As a result of incomplete cycles thick unit of graded graywacke might have developed at one place without slate phyllite, it may be totally missing elsewhere.

Turbidity currents must have been responsible for the formation of the graywacke as reflected by the graded bedding though their development may be due to factors other than seaquake as no pebble conglomerate is recorded. Lack of cross bedding suggests that the deposition was not related to fluvial or shallow marine condition. Absence of ripple-mark reflects deposition below wave base. Lack of zoned plagioclase and (iii) above indicates non derivation of sediments from any active mobile belt. On the contrary richness in feldspars in comparison to rock fragments points crystalline plutonic derivation. The nature of the quartz grains, the presence of pleochroic haloe in biotite and its alteration to chlorite, the nature of the matrix and the overall structural features are indicative of low grade regional metamorphism of the source region.

Thanks are due to Dr. K.K. Singh, Professor and Head, School of Studies in Geology, Vikram

University, for providing the laboratory facilities and guiding the junior author in the field.

This account forms part of a paper presented in the Ist Indian Geological Congress, Delhi 1976.

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Nat. Acad. Sci. Letters, Vol. 5, *No.* 1, 1982

SOLID POLYMORPHS OF p-AZOXYANISOLE (PAA)

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Received, March 6, 1981; *Revised, February* 11, 1982

A thermal study of solid polymorphism in liquid crystalline material p-azoxyanisole (PAA) reveals three solid modifications. Solid I (C_I) phase is stable at room temperature whereas monotropic solid II (C_{II}) phase is stable at higher temperature and the appearance of solid II (C_{II}) phase is dependent on the purity of the material. The formation of third metastable solid III (C_{III}) phase depends upon nucleation rate.

The nematic liquid crystalline material p-Azoxyanisole (PAA) is the simplest and first member of the classic series of 4,4'-di-n-alkoxyazoxy benzene. Arnold[1] was the first to carry out the precision calorimetry of this series of liquid crystals but he overlooked the existence of different solid phases before going to the nematic phase. In this communication, the detailed phase transition studies of PAA are reported alongwith the complete thermodynamic data.

A specially designed differential thermal analysis (DTA) apparatus was used for precisely recording the phase transitions. The heat of transition ($\triangle$H) was calculated by measuring the area of the transition peak by a planimeter. The spectroscopic grade PAA (purity 99.99%) was procured from M/s E. Merck, Germany and it was used as such.

The first DTA run was obtained by heating the room temperature solid (C_I phase) with a heating rate 5°K/min. It is shown in Fig. 1a and marked by two clear endothermic peaks at 388.0°K and 406.9°K constituting the phase transtions from solid I to nematic phase (C_I N) and from nematic to isotropic liquid (N-I transition) respectively. The DTA behaviour during cooling of isotropic liquid is shown in Fig. 1b which consists of three exothermic peaks corresponding to I-N (at 406.9°K), N-solid II (at 365.8°) and solid II-solid I (at 335.6°K) transitions. A new solid phase (solid II or C_{II}) thus emerges from nematic phase at a fixed temperature which transforms into the room temperature solid I phase at a lower temperature. It was also found that C_{II}-C_I transition temperature depends on the thermal history of the sample. If C_{II} phase was directly heated, the nematic phase was obtained at a lower temperature, 377.5°K than C_I-N transition and this DTA behaviour is shown in Fig. 1c. The transition temperatures, heat of transition ($\triangle$H) and transition entropy ($\triangle$S) for various transitions are listed in Table I.

The thermal behaviour of PAA sample during slow heating (heating rate 1°K/min) is shown in the Fig 1d. It results in an additional peak shouldering the main peak at C_I-N transition. The first peak is ascribed to C_{II}-N transition and the second peak stands for C_I-N transition. It leads to the

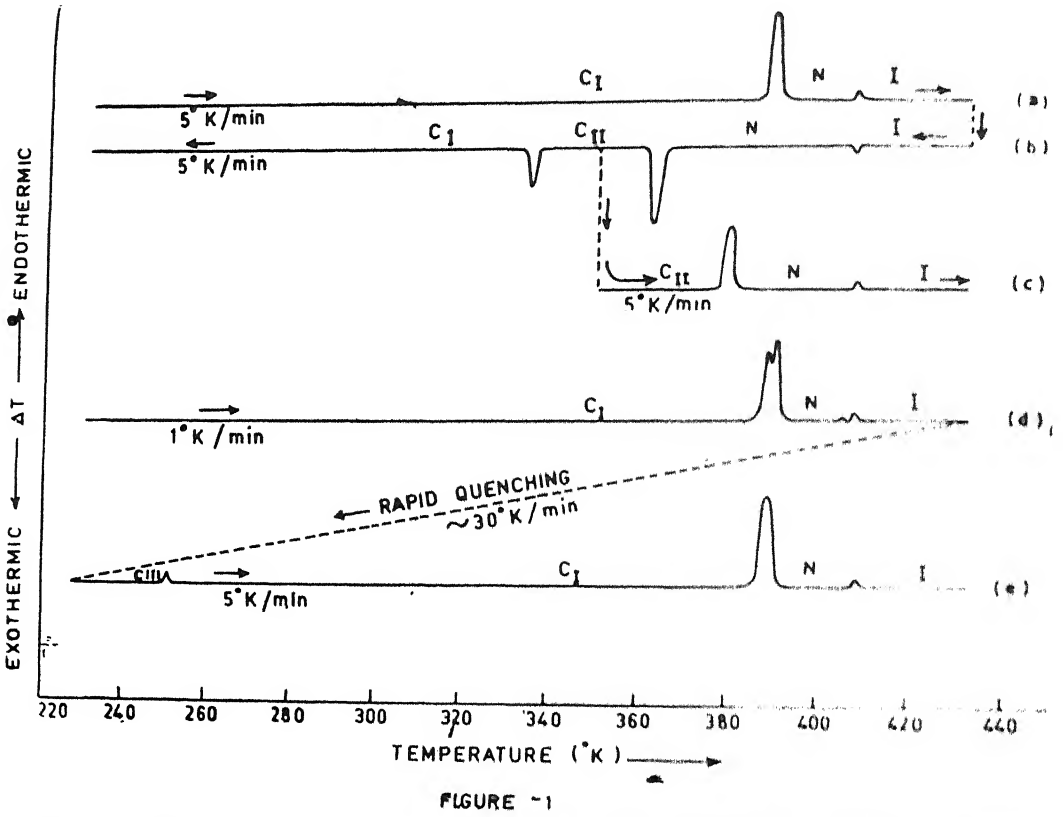

FIGURE -1

Figure 1 : Differential Thermal analysis (DTA) traces of PAA. The condition and manner in which various traces (a-f) were recorded are described in the text.

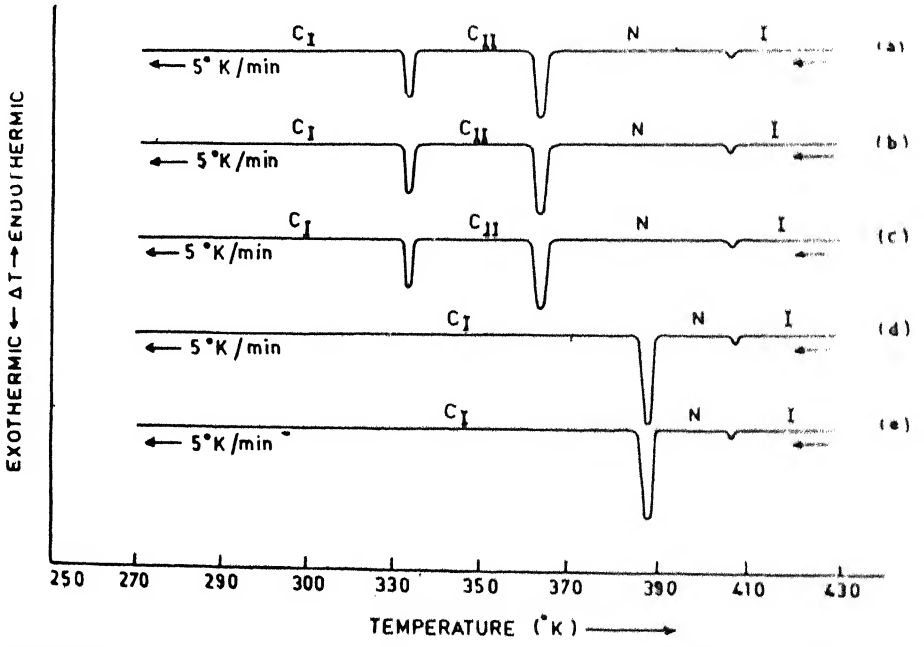

Figure 2 : DTA plots during cooling cycle for PAA samples having purity (a) 99.9% (b) 99.8% (c) 99.7% (d) 99.6% (e) 99.5%.

conclusion that metastable solid II phase can exist in various mixtures with solid I phase even at room temperature. The observation of a poorly marked endothermic peak just before the *N-I* indicates towards some pretransitional behaviour.

TABLE I

Heats of transition, transition entropies and transition temperatures of various phases of PAA

Transition	Transition Temp.(°K)	$\triangle H$ (Cal./mol.)	$\triangle S$ (Cal./mol./°K)
C_I-N	388.0	7273	18.74
N-I	406.9	181	0.44
N-C_{II}	365.8	7180	19.63
C_{II}-C_I	335.6	1040	3.10
C_{II}-N	377.5	5710	15.13
C_{III}-C_I	250.7	25	0.10

The effect of nucleation rate on the formation of solid phase was studied by quenching the isotropic melt with a rate greater than 30°K/min. As a result of rapid quenching, a new solid (solid III or C_{III}) phase was detected which transformed into room temperature solid I (C_I) phase at 250.7°K. This C_{III}-C_I transition is depicted by a very low peak of fusion in Fig. 1e alongwith usual C_I-N and N-I transitions.

Many workers[2,3,4] have studied the phase transitions in PAA but they did not notice various solid phases, possibly due to use of not so pure samples. Chow and Martire[5] has, however, detected solid II (C_{II}) phase by DSC and linked its emergence with the purity of the material. The effect of impurity on the appearance of solid II phase was also investigated in PAA samples of different purity and shown in Fig. 2. The C_{II} phase was observable in three samples having purity 99.9%, 99.8% and 99.7% whereas it was absent in the samples having purity 99.6% and 99.5%. The minimum purity thus required for the observation of monotropic C_{II} phase in PAA is 99.7%.

The author wishes to thank Prof. Suresh Chandra, Physics Department, BHU, Varanasi for helpful discussions.

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NEMATOSPIROIDES DUBIUS: ADOPTIVE TRANSFER OF IMMUNITY IN MICE THROUGH SINGLY AND REPEATEDLY SENSITIZED THYMUS AND BONE MARROW CELL COMBINATIONS

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Recieved Oct. 23, 1981, *Revised Jan.* 27,1982

Transfer of singly and repeatedly sensitized thymus and bone marrow cell combinations from donors infected with 100 and 100 + 100 *N. dubius* larvae respectively into recipient groups challenged 7 (recipients with singly and repeatedly sensitized cells) and 14 (recipients with singly sensitized cells only) days after cell transfer produced significant immunity in comparison to their counterpart controls. Recipients with either of the cell populations alone were less effective in responding to a challenge infection given 14 days after cell transfer.

Adoptive transfer of immunity in syngeneic recipients through sensitized cell populations from donors related to helminthic infections has been reviewed by Larsh[1]. Recently several workers have reported that immunity can be successfully transferred by means of sensitized cell populations in several experimental helminthic models[2-6]. In *N. dubius*-mouse model, Cypess[7] and Sanghvi *et al.*[8,9] have already shown the transfer of adoptive immunity through spleen, peritoneal exudate and mesenteric lymph node cells respectively. While working with the experimental infection of *N. dubius* in mice, an attempt was made to demonstrate whether thymus and bone marrow cells singly or in combination would successfully transfer adoptively acquired immunity since there already exists some experimental evidence indicating the important role thymus plays in lymphocytopoiesis and in the development of immune system[10]. Crowle[11] and Hilgard[12] have also shown that the thymus cells from sensitized donors were successful in conferring delayed type hypersensitivity.

Third stage infective larvae of *N. dubius* were cultured according to the modified method of Van Zandt[13]. Five groups (A,B, C, D and E) of female Swiss albino mice, 6-8 weeks old and approximately 20-23 g were taken. Each mouse of group A (30 animals) was infected per os with 100 *N. dubius* larvae; fourteen days later, thymus (T) and Bone marrow (B) cells were collected separately in Ringer's solution and within 4 hours of their collection were injected intraperitoneally into three separate recipient groups a_1 (received a mixture of 40×10^4 T cells), a_2 (received 40×10^4 B cells) and a_3 (received a mixture of 20×10^4 each of T and B cells). Groups b_1, b_2 and b_3 with nonsensitized cells collected from a group (B) of uninfected donors served as counterpart controls. Each mouse of donor groups C and D (25 mice in each) was infected per os with 100 and 100 + 100 (at weekly intervals) *N. dubius* larvae respectively; cells from thymus and bone marrow were collected 14 days postinfection and a mixture of 30×10^4 each of T and B cell populations were injected intraperitoneally into counterpart c and d

TABLE 1

Experimental schedule for sensitizing dose of *Nematospiroides dubius* larvae to donor mice and challenge infection to recipients following cell transfer.

Donor groups	A (singly infected)	B (control)	C (singly infected)	D (repeatedly infected)	E (control)
0	100	—	100	100	
7	—	—		100	
14	collection and intraperitoneal transfer of thymus (40×10^4 each mouse of a_1 and b_1), and bone marrow (40×10^4 each mouse of a_2 and b_2) and mixture of thymus and bone marrow (40×10^4 each mouse of a_3 and b_3; 60×10^4 each mouse of c, d and e)				
	a_1, a_2, a_3	b_1, b_2, b_3	c	d	e
21	Each recipient of c, d and e was orally challenged with a single dose of 100 *N. dubius* larvae				
28	Each recipient of a_1, a_2, a_3, b_1, b_2 and b_3 was orally challenged with a single dose of 100 *N. dubius* larvae.				

TABLE 2

Mean recovery of *N. dubius* larvae/adults from the gastrointestinal tract of experimental and control groups of recipients on days 1, 5, 9 and 14 after a challenge infection given 7 (groups c, d and e) and 14 (a_1, a_2 and a_3; b_1, b_2 and b_3) days after cell transfer. (Values are expressed in mean of recoveries made from 5 and 3 animals in groups challenged 7 and 14 days respectively).

Duration in days	Recipients with singly sensitized cells (experimental) c (T+B cells)	Recipients with repeatedly sensitized cells (experimental) d (T + B cells)	Recipients with nonsensitized cells (control) e (T + B cells)
1	65.0	59.0	70.0
5	61.8	54.2	68.2
9	59.2	40.2	59.7
14	57.8	39.8	56.0

	Recipients with singly sensitized cells (experimental)			Recipients with nonsensitized cells (control)		
	a_1 (T cells)	a_2 (B cells)	a_3 (T+B cells)	b_1 (T cells)	b_2 (B cells)	b_3 (B cells)
1	64.0*	60.0	47.0*	76.0	68.0	62.0
5	60.0*	55.0	42.0*	75.0	62.0	59.0
9	45.0	51.0*	35.0*	52.0	59.0	55.0
14	40.0	49.0	32.0	50.0	59.0	54.0

* statistically significant.

groups. A recipient group e with nonsensitized mixture of thymus and bone marrow cells collected from donor group E also served as counterpart control. Each recipient of groups c, d and e was challenged 7 and of a and b 14 days after cell transfer with a single dose of 100 N dubius larvae (Table 1). Immune response was assessed by counting larvae on days 1 and 5 and adults on 9 and 14 from the gastrointestinal tract of recipient mice necropsied. Data from experimental and counterpart control groups were compared statistically by applying Chi-square test.

There was no gradational decrease from day 1 to 14 in worm burden in all experimental and control groups; however, greater expulsion occurred in all experimental recipient groups when compared to corresponding controls. Recipients (groups c and d) with T + B cells (challenged 7 days after cell transfer) did not exhibit a tendency to expel significant worm burden (35.0%, 38.2%, 40.8% and 42.2% in group c and 41.0%, 45.8%, 59.8% and 60.2% in group d on days 1, 5, 9 and 14 respectively). Moreover, recipient of group a_3 (with T + B cells) challenged 14 days after cell transfer expelled significant worm burdens on days 1, 5, 9 and 14 from the gastrointestinal tract (53.0%, 58.0%, 56.0% and 58.0% respectively) indicating insufficient lapse of time for the sensitization of the recipients in groups c and d, although the number of cells injected were greater when compared to those in recipients challenged 14 days after cell transfer (group a_1). Recipients with sensitized T cells alone (group a_4) also caused significant expulsion of worms only on days 1 (36.0%) and 5 (40.0%) postchallenge.

Hence, recipients with T+B cells, when challenged 14 days after cell transfer only (irrespective of the number of cells injected) were active in causing significant expulsion of worm burden. The fact that recipients with T + B cells produced measurable amount of immune response throughout the experimental period than those with either T or B cells alone is similar to the findings of Claman *et al.*[14], who suggested that a single cell population is capable of inducing antibody formation (effector cells) only in the presence of cells from another cell population (auxilary cells). Claman *et al*[15] also reported that injection of T + B cells from adult donors into irradiated syngeneic recipient mice were able to provide greater stimulation to produce antisheep red cell hemolysin than either of the cell populations alone.

We thank Council of Scientific and Industrial Research and U. G. C. New Delhi, for financial assistance and also to the Sarabhai Research Centre, Baroda for supply of *N. dubius* strain.

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Nat. Acad. Sci. Letters, Vol. 5, No. 1, 1982

REMOVAL OF ENDOSULFAN FROM TREATED CHILLIES BY HOME PROCESSINGS

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Recieved Oct. 16, 1981; *Revised March* 13, 82

Colorimetric and *Drosophila* bioassay estimations have been made to study the removal of endosulfan deposits and residues by various home processings. The removal by 1 and 3 ms. washing was about 42% and 51% for lower, and 50% and 63% for higher deposits, and 12% and 24% for lower, and 18% and 36% for higher in one day residue: about 24% and 16% due to open cooking, 13% and 9% due to steam cooking and 49% and 36% due to dehydration respectively for lower and higher dosage applications. Processings are not very effective in removing endosulfan from chillies.

Environmental protection agency has recommended the use of endosulfan on vegetable crops with a waiting period of 0-4 days.[1] Being slightly systemic and parsistent endosulfan finds promise for the control of chilli pest complex and has also been recommended against chilli pests [2,3,4] in India. Endosulfan residues may, however, persist if sufficient preharvest waiting period is not observed, or if the insecticide is not used judiciously according to the recommended dosage[5], and marketed commodity may be contaminated with endosulfan residues exceeding the tolerance level which may prove hazardous to human health

Green chillies are eaten raw, when washing is the only processing before the actual consumption. It may also be cooked or dehydrated before consumption. These processings remove insecticide to some extent. The actual residue present in the chillies at the time when it is first offered as food, would therefore, depend to some extent on the nature and extent of processings.

Very little data is available on insecticide residues in chillies or the effect of processings on their removal from the treated chillies,[6,7] however, there is no earlier account either of endosulfan residues in chillies or their removal.

The present study was taken up in order to estimate the extent of removal of endosulfan by various processings from chillies to assess the implications if the farmer ignorantly uses more than the prescribed amounts of insecticide or does not follow the prescribed preharvest period.

For our studies chillies in small plots were sprayed to drenching with 0.1% and 0.2% sprays *@* 750l/ha using a fine nozzle hand compression sprayer. Both these concentrations were higher than those used by earlier workers. Three replicates were studied for each dose. Samples were drawn 4 hrs. after the spraying for the estimations of initial deposits and their removal by processings and again one day after the spraying to study the residues and their removal by washing.

For washing experiments complete chilli pods were washed for 1 or 3 ms. and then finely chopped and quartered for extraction. For heat processings, pods were finely chopped, quartered and then cooked open (10 ms), without addition of water by constant stirring in a porcelain crucible, steam cooked at 15 lb. pressure (10 ms.) in a pressure cooker or dehydrated at 58°C (18 hrs.) in a constant temperature oven. Samples (25g) were extracted with a mixture of 50 ml n-hexane and 25 ml propanol by tumbling over Krushov Ross Shaker for 3 hrs. Extract was cleaned up according to the method of Kathpal and Dewan[8] and micro-quantities of endosulfan were estimated according to colorimetric method after Maitlen[9] which is a modification of an earlier official method[10]. Parallel screening of the estimations was carried out using one day old male *Drosophila* for microbioassay[11] for confirmation of the results obtained colorimetrically and to account for toxic metabolites formed as a result of processings.

The efficiency of recovery of technical endosulfan from fortified chillies (4 hrs.) was found to be 82.08% and 84.85% by colorimetric and bioassay methods respectively. The percentage removal of endosulfan by various processings for a particular trial is with reference to the initial deposits on zero day or residues on lst day.

The results of Table 1 show that in both the dosage applications the initial deposits are fairly high, suggesting that the surface of chilli is highly receptive for EC formulation, of this insecticide.

Only about 17% and 13% reduction in residues on lst day in chilli treated respectively with 0.1% and 0.2% endosulfan indicates that the dissipation of endosulfan is rather slow in chilli.

Washing the treated pods respectively for 1 and 3 ms. removed about 42% and 51% endosulfan in case of lower dosage application and about 50% and 63% respectively in case of higher dosage application. The percentage removal of one day residues by 1 and 3 ms. washing was lesser, being only about 12% and 24% in case of lower, and 15% and 36% in case of higher dosage application. It may be inferred that per cent removal of deposits as well as residues is more for higher dosage than the lower. Washing removes endosulfan deposits from chilli to greater extent than its residues in it. It seems probable that the lipid contents in the epidermis of chilli traps endosulfan. This factor along with its translocation in the pod result in lesser removal of insecticide residues by washing. The capacity of endosulfan to penetrate epidermis is well established [12]

In case of lower dosage application, the removal of endosulfan deposits respectively by open and steam cooking was to the extent of about 34% and 13%, whereas in case of higher dosage application these processings removed only about 17% and 10% respectively. Thus, the extent of removal is more in case of lower dosage than the higher, and is greater for open cooking than steam cooking.

Thermal dehydration removed about 49% and 36% endosulfan deposits in case of lower and higher dosages respectively, the removal per cent being more for lower dosage application than higher.

The coefficient of correlations between colorimetric estimations and *Drosophila* bioassay shown in Table 1 indicates that there is very little variation between the results by the two methods. The degradation and oxidation products of endosulfan, are therefore, almost equally toxic to the parent compound within range.

Although residue data of endosulfan is not known for chillies, the high initial deposits and low dissipation on lst day are suggestive that the residues may

fall below tolerance level of 2 ppm only after fairly long waiting period. Since the removal of endosulfan by home processings is also not so much as in case of other vegetables,[13,14] the recommendation of endosulfan on chillies needs careful scrutiny and the insecticide may be used only with great precautions as higher concentration or short waiting period may prove hazardous.

Financial assistance form ICAR for this work is gratefully acknowledged. Authors thank Prof. U.S. Srivastava, Head of the Zoology Department, University of Allahabad, for extending facilities for the work.

TABLE 1

Effect of home processings on the removal of endosulfan from treated chillies.

Processings	Lower dose (0.1% Spray)			Higher dose (0.2% Spray)		
	Average* Rec/g	Average% Removal	Coefficient of Correlation	Average* Rec/g	Average% Removal	Coefficient of Correlation
Initial deposit	36.87 (35.82)		1.001	41.21 (38.76)		0.898
Zero day washing 1 minute	15.73 (14.29)	41.76 (45.06)	0.995	20.49 (19.20)	50.24 (50.49)	0.922
Zero day washing 3 minutes	13.02 (12.15)	51.33 (52.98)	0.993	15.08 (14.21)	63.49 (63.36)	0.989
Open Cooking	20.46 (19.00)	23.71 (26.33)	0.994	34.46 (31.80)	16.48 (18.11)	0.978
Steam cooking	23.49 (21.45)	12.58 (17.14)	0.997	37.38 (34.28)	9.35 (11.72)	0.984
Dehydration	13.81 (12.85)	48.87 (50.49)	0.988	26.57 (24.93)	35.66 (35.90)	7.967
Residue one day	22.25 (20.39)	17.07 (20.93)	0.985	36.03 (32.53)	12.60 (16.09)	0.970
One day washing 1 minute	19.67 (17.70)	11.55 (13.24)	0.989	29.50 (26.78)	18.23 (18.74)	0.999
One day washing 3 minutes	16.96 (15.27)	23.99 (26.80)	0.946	23.19 (20.87)	35.85 (37.26)	0.995

(Values within parenthesis are for *Drosophila* microbioassay method)

* Average of three replicates

Rec/g Recovery per gram.

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Nat.Acad Sci. Letter, Vol. 5, *No.* 1, 1982

BIOCHEMICAL COMPOSITION OF BLOOD, LIVER AND MUSCLE OF *SAROTHERODON* (*TILAPIA*) *MOSSAMBICUS* (PETERS)

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The various metabolites of blood, liver and muscle of *Sarotherodon mossambicus* after being transported from the field were studied. The results are of importance in designing studies under different experimental conditions.

Studies on the principal biochemical components in different tissues of a fish would be of considerable interest, as they reflect the food value of a species.[1] Moreover, establishment of normal values would help to understand the influence of various physiological and environmental factors operating on them. Blood glucose in different species of fish have been established by a number of workers under different physiological conditions[2]. Similarly normal values of cholesterol, glycogen, water, protein and total fat in various tissues of fish have been reported by several investigators[3,4]. In the present investigation some of the prinicipal metabolites of blood, liver and muscle involved in the carbohydrate metabolism of *Sarotherodon mossambicus* are summarized. The various metabolites include water content, TCA-soluble total carbohydrates, free sugars, glycogen, lactic acid and pyruvic acid. In addition, total protein content was also estimated. The analyses were made at intervals of 24 hours, 7 days and 15 days after the fishes were brought from the field, with a view to assessing the impact of transportation and subsequent acclimatization in the laboratory.

The specimens employed were brought from a local pond three kilometer away from the laboratory. The total carbohydrates and glycogen were determined following the anthrone method of Roe[5] and Carrol et al.[6] respectively. The amount of free sugar in tissues was calculated by subtracting the amount of glycogen from the amount of total carbohydrates. Barker and Summerson[7] method was followed for the estimation of lactic acid. Pyruvic acid content was determined following the procedure of Friedemann and Haugan.[8] Total protein was determined following the procedure of Lowry et al.[9] Anova was used to determine the significance in the variations between the values obtained at different intervals.

A perusal of table 1 reveals that among the various components, only the blood sugar and lactic acid in blood and muscle showed significant differences between the intervals. Increase of lactic acid in blood and muscle of Kamloops and lake trout has been encountered in the studies of Black[10], even one hour after transportation. Similarly persistance of blood sugar variation in fishes soon

after capture in the field and also due to other stress factors has been demonstrated by several workers. [2,11]. The absence of considerable variations in other components in present study would help to interpret the values obtained in fishes subjected to different physiological and environmental parameters.

TABLE 1

S.No.	Metabolites	24 Hours	7 Days	15 Days	S/I.S.
1.	Blood water content	81.85±4.74 mg %	83.40±2.41 mg%	81.42 ± 3.55 mg%	I.S
2.	Blood Total carbohyraterates	42.86±5.20 mg ,,	35.85±2.63 mg ,,	38.76 ± 2.44 mg ,,	S (P 0.05)
3.	Blood Lactic acid	22.16 ±5.55 µg/ml	14.75 ±4.12 µg/ml	22.41 ±10.37 µg/ml	S (P 0.05)
4.	Blood Pyruvic acid	12.88 ±1.43 µg/ml	12.93 ±0.97 µg/ml	12.94 ± 0.93 µg/ml	I.S
5.	Liver water content	78.96 ±9.51 mg %	81.50 ± 2.32 mg ,,	79.25 ± 4.50 mg %	I.S
6.	Liver glycogen	5.83 ±0.72 mg ,,	5.32 ± 0.59 mg ,,	5.88 ± 1.07 mg ,,	I.S
7.	Liver Free sugars	3.41 ±0.48 mg ,,	3.85 ±0.58 mg ,,	3.12 ± 0.34 mg ,,	I.S
8.	Muscle water content	77.90 ±1.30 mg ,,	79.80 ±3.21 mg ,,	80.64 ± 1.35 mg ,,	I.S
9.	Muscle glycogen	0.15 ±0.020mg ,,	0.16 ±0.022mg ,,	0.18 ± 0.035mg ,,	I.S
10.	Muscle free sugars	0.274±0.023mg ,,	0.274 ± 0.027mg ,,	0.267 ± 0.029mg ,,	I.S
11.	Muscle lactate	32.32 ±8.38 µg ,,	21.99 ±2.69 µg ,,	48.01 ± 10.17 µg ,,	S (P 0.05)
12.	Liver lactate	18.00 ±8.22 µg ,,	17.52 ±2.61 µg ,,	16.14 ± 8.55 µg ,,	I.S
13.	Muscle pyruvate	0.82 ±0.25 µg ,,	0.74 ±0.05 µg ,,	0.62 ± 0.03 µg ,,	I.S
14.	Liver pyruvate	1.69 ±0.47 µg ,,	2.21 ±0.30 µg ,,	2.33 ± 0.51 µg ,,	I.S
15.	Liver Total protein	17.50 ±2.73 mg ,,	17.85 ±0.55 mg ,,	18.30 ± 0.80 mg ,,	I.S
16.	Muscle Total protein	12.07 ±1.62 mg ,,	13.34 ±0.33 mg ,,	11.42 ± 1.35 mg ,,	I.S

* The values are given for 100 mg wet tissue for liver and muscle. S-Significant; I.S Insignificant

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